(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 June 2003 (26.06.2003)

PCT

(10) International Publication Number
WO 03/052238 A1

(51) International Patent Classification[7]: E21B 43/04, 43/11

(21) International Application Number: PCT/US02/40696

(22) International Filing Date: 18 December 2002 (18.12.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/341,779 18 December 2001 (18.12.2001) US

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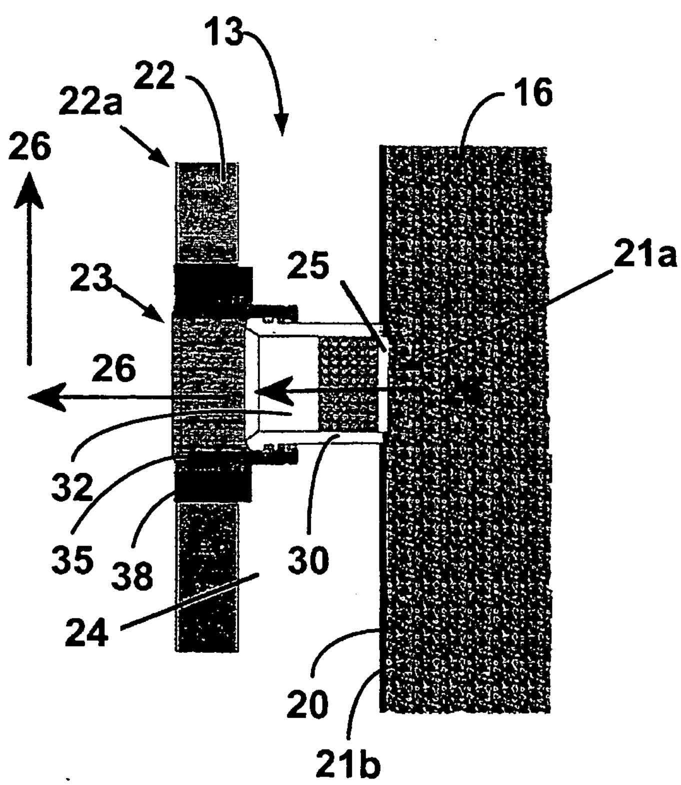
(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SI, SK,

[Continued on next page]

(54) Title: A DRILLING METHOD FOR MAINTAINING PRODUCTIVITY WHILE ELIMINATING PERFORATING AND GRAVEL PACKING



(57) Abstract: A method for well construction and completion is disclosed. First, a productive section of a well is drilled in the presence of a fluid system that controls fluid losses, is substantially non-damaging to the formation and includes particles in a particle size distribution sufficient to form a low permeability filter cake on a formation face and to allow the majority of the filter cake particles to flow back into the borehole after well completion. after drilling, a casing includes at least one and preferably a plurality of extendable permeable elements or member is run in the well so that the elements are positioned and aligned with sites in the producing formation and once extended form production conduits between the formation and an interior of the casing. A completed borehole is also disclosed including a casing having production conduits formed from the extendable members or elements.

WO 03/052238 A1

TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

PCT SPECIFICATION

TITLE: A DRILLING METHOD FOR MAINTAINING PRODUCTIVITY WHILE ELIMINATING PERFORATING AND GRAVEL PACKING

BACKGROUND OF THE INVENTION

1. **Field of the Invention**

[0001] This invention relates to a method of drilling and completing a well.

[0002] More particularly, this invention relates to a method for placing a means of communication between a productive formation and a well borehole without perforating and gravel packing the well borehole at sites of production. The method also relates to minimizing formation damage caused by conventional drilling, perforating, and gravel packing. The method combines and integrates elements of well drilling and construction with the well completion in a manner to reduce time, improve safety, and maximize productivity.

2. **Description of the Related Art**

[0003] The search for oil and gas reserves has taken the industry to remote sites including land, traditional offshore locations, and offshore deepwater. Historically the cost for exploring and developing hydrocarbons has been very high, and as the search for hydrocarbons continues in more remote areas costs are escalating because of the amount of equipment and personnel required in these areas. Because of the escalating cost it is important, that formation damage be minimized. Formation damage can negatively affect productivity of the resulting wells. Productivity needs to be as high as possible in order to ensure profitability. Also, it is important to seek ways to reduce the time spent on well construction and completion operations to minimize cost and if the number of personnel and the amount of equipment can be reduced safety inherently improves.

[0004] Many hydrocarbon reservoirs are by their very nature unconsolidated rock and/or sandstone. These unconsolidated formations may produce sand particles and other debris which can cause well bore and surface facility problems as well as negatively affecting the productivity of the well. Therefore, means of preventing sand production have been developed throughout the years.

[0005] One common method of well construction and completion is to drill a borehole with conventional drilling fluids, run casing into the borehole and cement the casing in place, displace the conventional drilling fluids with a clear brine, filter the brine and clean the

borehole, run perforating guns in the well and perforate the casing, remove the perforating guns and re-clean the casing, re-filter to the clear brine fluids, run in the well with a gravel pack screen assembly, use high-pressure pumps place gravel pack sand between the gravel pack screen assembly into the perforation tunnels and against the formation face. This is a costly, time-consuming process.

[0006] There are many disadvantages from the above procedure. These disadvantages can be broken into two categories; equipment and process reliability, and formation damage mitigation or removal. Fluid losses of the filtered brine can occur after perforating necessitating the need for a means of fluid loss control which generally entails pumping high viscosity polymer gel into the formation. There have been instances where leaks have caused perforating guns to low order detonate resulting in no or poor perforating performance and expensive fishing operations to remove the damaged perforating gun bodies. Also, gravel pack screens have failed during the high-pressure pumping operation causing additional fishing operations or worse the damage isn't discover until the well is placed on production necessitating a workover of the well.

[0007] Formation damage is also a problem during conventional well construction and completion. Conventional drilling fluids can allow filtrate and solid particles to invade the formation causing restrictions in the productive pore spaces. Another source of formation damage is the shaped charges or explosives used in perforating. The energy from these explosives pushes the casing, cement, and formation aside when creating the perforation tunnel. This causes crushing of the formation matrix reducing the permeability and flow potential of the formation. Additional damage can come from the polymer gels used for controlling fluid losses after formation perforation. One method currently used to over come formation damage is hydraulic fracturing or frac packing. Frac packing is an attempt to use high-pressure pumping and hydraulic horse power to frac beyond any damage. Another method for formation damage mitigation uses acid stimulation to try and remove or dissolve formation damage caused by polymer gels or mud particle invasion. However, most mud weighting materials are solid mineral particles such as barite and bentonite that cannot be readily dissolved.

[0008] The gravel pack assembly itself can serve as the restriction in the well borehole. This may cause unnecessary pressure drops which restrict production. Also, the gravel pack assembly may need to be removed for remedial operations. The process of removing an

object from a well borehole is called fishing. These operations are costly and time consuming and not always successful resulting in a need to re-drill a portion of, or possibly the entire well.

[0009] Another common method of well construction and completion is to drill a borehole and not run casing across the productive formation. This type of well construction is termed barefoot or openhole. Openhole completions are generally utilized after horizontal well construction. The most common practice is to run a screen assembly in the openhole section and not gravel pack on the outside of the screen between the screen and the formation. However, there has been an increasing number of openhole horizontal gravel packs performed. Formation damage is mitigated by the use of special drilling fluids termed "Drill-In-Fluids." A common problem with this type of completion is the inability to isolate areas in the completion that produce water. Water production can increase to a point that limits hydrocarbon production rates. Isolating and stopping areas of water production is made extremely difficult due to not having cemented casing in-place to help control the flow of water in the annulus between the screen and the formation. Also, the screens run in the horizontal openhole generally contain a sand control filter media. The horizontal openhole section can act as a gravity separator during production. Because the unconsolidated formation material is not kept in place with gravel pack sand in the annulus between the screen and formation, it is free to move during production. The produced fluids having a certain velocity will carry smaller formation particles more easily and at a higher velocity than the larger formation particles. Because the filter media is usually designed on the midrange particle size based on the overall particle size distribution of the formation, the smaller formation particles tend to plug the screen's sand control filter media instead of bridging on the surface of the filter media with the larger formation particles. This plugging restricts the production potential of the well and may cause a workover or loss of hydrocarbon recovery from the reservoir.

[0010] Attempts to introduce devices which eliminate perforating and gravel packing are not new and have been disclosed in the past. Zandmer in U.S. Pat. No. 3,347,317 disclosed an extendable duct with solid particles acting as a gravel pack medium. Johnson disclosed an extendable device in PCT application publication number WO9626350. These devices have not been widely used. These devices trap drilling mud filter cake between the sand control filter media and formation face which limit productivity due to plugging of the formation and

filter media. The drilling fluids used in the well construction process generally contain minerals such as barite, bentonite, and/or clays in the form of solid particles. These particles form a filter cake on the formation face as the well is drilled. These filter cakes have a leak off rate which allows filtrate and smaller particles to enter the pore spaces of the formation and can cause considerable damage to a formation's productivity. The same filter cake can plug the sand control filter media utilized in the devices described above. In another invention disclosed by Reinhardt in U.S. Pat. No. 5,425,424, no gravel pack median is used in these extendable ducts. However, productivity is maximized by performing a hydraulic fracture treatment after extending the perforation ducts. Hydraulic fracturing is a method of bypassing formation damage and/or improving conductivity between the productive formation and the well borehole.

[0011] Therefore, there is a need for a method of well construction and completion that minimizes formation damage, maximizes well productivity, and provides a means of formation isolation. Further, there is a need for a method that minimizes time spent during well completion and that improves process reliability and safety. For cased and cemented wells, there is a further need to integrate well construction and completion processes eliminating well perforation and gravel packing operations, while maximizing formation productivity. The present invention answers these needs in a cross disciplined integration of well construction (drilling) and completion processes to maximize formation productivity.

SUMMARY OF THE INVENTION

[0012] The present invention provides a method for drilling and completing a well, where the method achieves improved formation productivity without the need for well perforation and gravel packing.

[0013] The present invention provides a method of well construction and completion including the steps of drilling an interval of a well into or into and through a productive formation in the presence of a fluid system adapted to control fluid loss, to be substantially non-damaging to the productive formation, and to form a filter cake having substantial flow back properties minimizing adverse affects on formation productivity. After the productive interval is drilled, a casing string including at least one and preferably a plurality of laterally extendable members having a sand control medium associated therewith is run into the well so that the members can be deployed to contact sites in the productive interval, *i.e.*, the extendable members are positioned and aligned within the productive formation interval of

the well. After the casing has been properly run into the well, the members are extended such that each member comes into contact with the filter cake and/or the productive formation at their associated sites, where the contacting in sufficient to allow productive formation fluids to flow through the member into the casing and out of the well. Once the members are deployed forming production conduits between an interior of the casing and the formation, the casing is cemented in place. After casing cementing, production tubing/equipment is run into the well borehole and the well is placed on production.

[0014] The present invention provides a method of well construction and completion including the steps of drilling an interval of a well into or into and through a productive formation in the presence of a fluid system characterized by having a hydrostatic pressure equal to or less than the formation pressure to minimize or eliminate the formation of a filter cake on the formation face, so called under balanced or near balanced drilling. After the productive interval is drilled, a casing string including at least one and preferably a plurality of laterally extendable members having a sand control medium associated therewith is run into the well so that the members can be deployed to contact sites in the productive interval, *i.e.*, the extendable members are positioned and aligned within the productive formation interval of the well. After the casing has been properly run into the well, the members are extended such that each member comes into contact with the filter cake and/or the productive formation at their associated sites, where the contacting in sufficient to allow productive formation fluids to flow through the member into the casing and out of the well. Once the members are deployed forming production conduits between an interior of the casing and the formation, the casing is cemented in place. After casing cementing, production tubing/equipment is run into the well borehole and the well is placed on production.

[0015] The present invention provides a method of well construction and completion including the steps of drilling a first interval of a well through non-productive formations in the presence of a first fluid system. Prior to drilling into or into and through a productive formation, the first drilling fluid is replaced with a second fluid system adapted to control fluid loss, to be substantially non-damaging to the productive formation, and to form a filter cake having substantial flow back properties minimizing adverse affects on formation productivity. After fluid system replacement, a second interval of the well is drilled into or into and through a productive formation in the presence of the second fluid system. After the productive interval is drilled, a casing string including at least one and preferably a plurality

of laterally extendable members having a sand control medium associated therewith is run into the well so that the members can be deployed to contact sites in the productive interval, *i.e.*, the extendable members are positioned and aligned within the productive formation interval of the well. After the casing has been properly run into the well, the members are extended such that each member comes into contact with the filter cake and/or the productive formation at their associated sites, where the contacting in sufficient to allow productive formation fluids to flow through the member into the casing and out of the well. Once the members are deployed forming production conduits between an interior of the casing and the formation, the casing is cemented in place. After casing cementing, production tubing/equipment is run into the well borehole and the well is placed on production.

[0016] The present invention provides a method of well construction and completion including the steps of drilling a first interval of a well through non-productive formations in the presence of a first fluid system. Prior to drilling into or into and through a productive formation, the first drilling fluid is replaced with a second fluid system characterized by having a hydrostatic pressure equal to or less than the formation pressure to minimize or eliminate the formation of a filter cake on the formation face. After fluid system replacement, a second interval of the well is drilled into or into and through a productive formation in the presence of the second fluid system, so called under balanced or near balanced drilling. After the productive interval is drilled, a casing string including at least one and preferably a plurality of laterally extendable members having a sand control medium associated therewith is run into the well so that the members can be deployed to contact sites in the productive interval, *i.e.*, the extendable members are positioned and aligned within the productive formation interval of the well. After the casing has been properly run into the well, the members are extended such that each member comes into contact with the filter cake and/or the productive formation at their associated sites, where the contacting in sufficient to allow productive formation fluids to flow through the member into the casing and out of the well. Once the members are deployed forming production conduits between an interior of the casing and the formation, the casing is cemented in place. After casing cementing, production tubing/equipment is run into the well borehole and the well is placed on production.

[0017] The methods of this invention can also include steps designed to remove or reduce the filter cake deposited on the formation face during the drilling operation by pumping a

solvent into the well for a time sufficient to remove some or substantially all of the filter pack. The filter pack removal step can occur before or after member extension or before or after well cementing.

[0018] The present invention further provides a completed well including a casing string including at least one and preferably a plurality of extended members having a sand control medium associated therewith, where the members extend out from the casing and contact sites in a productive formation forming production conduits through which formation fluid flow into an interior of the casing and out of the well. The member includes a casing fitting, an inner sleeve having inner sleeve stops and an outer sleeve having outer sleeve stops, where the sleeves are movable from a retracted state to an extended state when a sufficient hydraulic pressure is applied to the members.

DESCRIPTION OF THE DRAWINGS

[0019] The invention can be better understood with reference to the following detailed description together with the appended illustrative drawings in which like elements are numbered the same:

[0020] Figure 1 is a schematic illustrating drilling a well to a point above the anticipated productive formations;

[0021] Figure 2 depicts a schematic illustrating drilling through a productive formation with a "Drill-In Fluid" including a logging while drilling tool which can be used to determine the depth and length of productive formations;

[0022] Figure 3 depicts a schematic illustrating the benefits of using a "drill-in-fluid" drilling fluid vs. a conventional drilling fluid;

[0023] Figure 4 depicts a schematic illustrating running the extendable devices on the casing and positioning them across from the productive formation;

[0024] Figure 5 depicts a schematic illustrating extending the devices to contact the formation face and centralize the casing;

[0025] Figure 6 illustrates the casing been cemented into place; and

[0026] Figure 7 depicts a schematic illustrating the well in a producing mode.

DETAILED DESCRIPTION OF THE INVENTION

[0027] The inventor has found that an oil and/or gas well can be drilled and completed without the need for formation perforation and gravel packing using a casing including at least one, but preferably a plurality of extendable members adapted to form production

conduits between a productive formation and an interior of the casing. The members are hydraulically extendable from a retracted stated to an intended state and include a casing fitting, an inner sleeve, inner sleeve stops, an outer sleeve and outer sleeve stops, where the sleeve are movable between the retracted state and the extended state to form a telescoping conduit. In the extended state a distal end of the member is designed to contact a site on a face of a productive formation, where the contact is sufficient to allow fluid flow from the formation through an interior of the extended member and into an interior of the casing.

[0028] This invention broadly relates to methods for drilling and completing a well including the step of drilling a productive interval of a well with a fluid system selected from the group consisting of a fluid system adapted to control fluid loss, to be substantially non-damaging to the productive formation, and to form a filter cake having substantial flow back properties minimizing adverse affects on formation productivity, a fluid system characterized by having a hydrostatic pressure equal to or less than the formation pressure to minimize or eliminate the formation of a filter cake on the formation face and mixtures or combinations thereof. After drilling into or into and through the productive formation, casing including at least one and preferably a plurality of extendable members having a sand control medium associated therewith is run into the well so that the extendable members are positioned and aligned within the productive formation so that when extended the member form production conduits between sites of the productive formation and an interior of the casing. After proper casing positioning, the member are extended hydraulically to form the conduits and the casing is cemented in place. After cementing, the well can be placed on production. Alternatively, cementing of the casing can proceed extending of the member to form permeable elements or production conduits.

[0029] The present invention also broadly relates to a completed oil and/or gas well including a casing having at least one, but preferably a plurality of, extendable member formed within sections of the casing, where the sections of the casing are positioned in productive formation so that the extendable members can form production conduits or permeable elements at desired sites within the productive formation once extended. The present invention also broadly relates to a producing oil and/or gas well including a casing having at least one, but preferably a plurality of, extendable member formed within sections of the casing, where the sections of the casing are positioned in productive formation and where the extendable members are extended to form production conduits or permeable elements at desired sites

within the productive formation. The extendable members include a casing fitting adapted to secure the member to a portion of the wall of a casing section, an inner sleeve, an inner sleeve stop, an outer sleeve, an outer sleeve stop and a sand control medium disposed in a distal section of an interior of the inner sleeve, where the sleeves are designed to move from a retracted state to an extended state to form a telescoping conduit and a distal end is designed to contact a site of a productive formation forming a production conduit with the sand control medium interposed between the formation and an inner of the casing.

[0030] The productive formations can be identified during well construction by utilizing logging while drilling tools or openhole electric logs. These tools identify the productive formations depth and thickness of the productive formations. The extendable members which will replace the perforation and gravel pack completion are spaced out on the casing string to allow them to be aligned with the productive formations as determine by the well logs. Depending on the expected productivity of the formation generally between 1 and 12 extendable members per foot may be required to effectively drain a reservoir. In many cases 4 extendable members per foot will be adequate. The casing is then run into the borehole such that the extendable members are positioned opposite the productive formation. The extendable members are extended mechanically, or hydraulically or a combination of mechanical and hydraulic means. This allows the devices to come in contact with the filter cake and formation face. Also, the devices will help centralize the casing in the borehole. The casing is then cemented. The production tubing/equipment is then run into the well. Depending on the type of "Drill-In Fluid" used in the drilling process, the well may be placed on production or solvents pumped to remove the filter cake. If the well has been drilled in an under balanced or near balanced condition, there should be little if any filter cake to remove.

[0031] Suitable fluid systems for using in drilling the intervals of a well that penetration into or into and through a productive formation include, without limitation, any fluid system comprises a fluid carrier and particles, where the particles have a particle size distribution for forming a low permeability filter cake on a formation face as the well is drilled and where the particle size distribution is designed so that a majority of the particles in the filter cake flow back into the casing through a sand control filter medium associated with the extendable members and minimizing adverse affects on formation productivity. One such fluid system for drilling the productive formation is disclosed in U.S. Pat. No. 5,504,062 to Johnson,

incorporated herein by reference. Those skilled in the art will recognize that these types of fluid systems have the ability to minimize filtrate and particle invasion into the formation. U.S. Pat. No. 5,504,062 also disclosed, a formulation of particle sizes that protect the formation and flow back through conventional gravel pack media with minimal damage to the production potential of a formation. These fluids have been designed for use in openhole well construction; more particularly they are used for openhole horizontal drilling. Other fluid systems are disclosed U.S. Pat. No. 4,620,596, 4,369,843; and 4,186,803 to Mondshine, incorporated herein by reference. The fluid system includes sized salt particles ; which protect the formation during well construction and workover operations. The fluids disclosed by Mondshine have been applied as drilling fluids in horizontal openhole well construction. If the fluids disclosed by Mondshine are used in the present invention, a solvent would be required to reduce the filter cake particle sizes or completely dissolve the salt particles in the filter cake. These particular fluids are of interest in the invention because the solvent may come from conate water, water already present in the formation, which would dissolve the salt particles insitu and eliminate having to pump an acid or solvent into the well prior to production. While the use of the fluids mentioned above are preferred embodiments for the inventive method, the use of these fluid systems should not be interpreted as a limitation. As new polymers and fluid formulations are tested and become available in the market which protect the formation and have the ability to be dissolved or sufficiently flow back through the gravel pack filter medium to maximize productivity. These fluids, which are used in well construction for drilling openhole horizontal wells, are a class of drilling fluids known as "Drill-In Fluids."

[0032] Referring to Figure 1, a drilling vessel or platform **2** including a drilling rig **1**. A subsea blowout preventer stack **3** may be positioned on an ocean floor **3a** in offshore application. The well casing string **45** includes a conductor elements **4**, a surface element **5**, and an intermediate element **6**. As is well understood by those of ordinary skill in the art, the casing string is placed in boreholes and then cemented in place. As is shown in Figure 1, drilling of a well borehole **50** is continued to a target reservoir **16**. The drilling assembly **55** includes of a drill string **7**, logging while drilling formation evaluation sensors **8**, a drilling motor **9**, a drill string stabilizer **10**, and a drill bit **11**. As is shown in Figure 1, the bottom hole assembly **12**, includes the logging while drilling formation evaluation sensors **8**, the drilling motor **9**, the drill string stabilizer **10**, and the drill bit **11**.

[0033] As shown in Figure 1, the bottom hole assembly **12** has intersected a marker formation **15**. The marker formation **15** is a selected geological indicator that is reached prior to the borehole **50** intersecting the target formation **16**. The marker formation **15** provides an indication of the additional drilling depth needed drill from a current bottom hole position **14** to the target formation **16**. When the bottom hole position **14** is approximately 200 to 500 feet above the target formation **16**, conventional drilling mud is displaced with a "Drill-In Fluid" selected to protect the formation in the target reservoir **16** during drilling into or into and through the target formation **16**. The "Drill-In Fluid" displaces the conventional mud by pumping the "Drill-In Fluid" into the drill string **7** pushing the conventional drilling fluid out of the borehole **45** via return up an annulus space **13**.

[0034] Referring now to Figure 2, drilling of the borehole **50** is continued and extended into or into and through the target reservoir **16** using the "Drill-In Fluid". The bottom of the well **14** is now shown extended through the target reservoir **16**.

[0035] Referring now to Figure 3, the target reservoir **16** has a formation matrix **27** including solid particles **18** and pore spaces **17**. The pore spaces **17** are the area in the formation that generally contains oil, gas, and/or water. Looking at Figure 3B, an example of what can happen to a formation matrix **28** is graphically depicted if a conventional drilling fluid is used to drill into and through the target reservoir or formation **16**. As can be seen in the formation matrix **28**, a filter cake **19** has been formed from on a face **28a** of the matrix **28** and mud filtrate and solid particles have invaded the pore spaces **17** which can cause a reduction in well productivity. Looking at Figure 3C, a formation matrix **29** is shown depicting the use of a "Drill-In Fluid" for drilling within the target reservoir **16**, which forms a filter cake **20** with little or no invasion of particulate into the pore spaces **17** protecting the formation matrix **29**. This type of fluid will minimize any negative effects on productivity.

[0036] After reaching the total depth **14** as shown in Figure 2, the drill string **7** and bottom hole assembly **12** are pulled from the borehole **45**. Casing is run into the well. The casing will have extendable members positioned such that when the casing reaches the bottom of the borehole **14** the extendable members are positioned and aligned with sites in the target reservoir **16**.

[0037] Referring now to Figure 4, a section **21** of the target formation or reservoir **16** is depicted showing an adjacent portion **22a** of a casing **22** having an extendable member **23** aligned adjacent a site **21a** of the section **21** of the target reservoir **16**. Although Figure 4 shows only a single member **23**, a plurality of members **23** can be associated with sections of the casing in a spaced apart configuration to provide a plurality of production conduits within the target reservoir **16** depending on the production requirements of the reservoir **16**. In one preferred arrangement, four extendable members per foot of formation are used to provide an adequate number of production conduits for most formations within producing hydrocarbon reservoirs. However, lesser and greater number of extendable members can be used as well depending on the desired production level. Generally, the number of extendable members will be between 1 per foot of formation to about 20 per foot, with between 2 and 10 being preferred and between 3 and 8 being particularly preferred.

[0038] Referring back to Figure 4, an extendable member **23** is shown in its run position or retracted state. The extendable member **23** includes an inner sleeve **30** having an inner sleeve lip **31**, an interior **32**, a sand control medium **33** disposed in a distal end portion **34** of the interior **32**, an outer sleeve **35** having an inner sleeve stop **36** and an outer sleeve lip **37** and a fitting **38** having an outer sleeve stop **39**, where the fitting **38** is adapted to attach the member **23** to the casing **22**. The annulus **13** may be filled at this point with "Drill-In Fluid" or the "Drill-In Fluid" displaced with a solids free fluid. A filter cake **20** protects a face **21b** of the formation section **21**.

[0039] Referring now to Figure 5, the expendable member **23** is shown in its extended state, where hydraulic pressure has been used to force a distal end **40** of the member **23** in contact with a portion **25** of the filter cake **20** associated with the site **21a** of the section **21** of the formation **16**. The well is now ready to be cemented.

[0040] Referring now to Figure 6, the annulus **13** is shown filled with a cement **24** isolating the section **21** of the formation **16**, except for flow control points associated with the extendable members **23**. At this point production tubing/equipment is run into the well and the well made ready for production.

[0041] Referring now to Figure 7, the formation section **21** is shown producing through an interior **32** of the extendable member **23**. It should be noted that fluid **26** produced from formation section **21** has removed the portion **25** of the filter cake **20** in the area constrained by the extendable member **23**. The produce fluids **26** travel through the interior **32** of the

extendable member **23** into an interior **22b** of the casing **22**. The produced fluids **26** continue up the casing **22** and eventually enter the production tubing. They produced fluids **26** which may contain oil, gas, and/or water flow to the surface via the production tubing for processing and/or sale. Should production not reach expected levels quickly enough a solvent may be used to facilitate filter cake removal.

[0042] All references cited herein are incorporated by reference. The terms comprising, including and having are equivalent open ended claim terms and are used interchangeable to make the claims for understandable. While this invention has been described fully and completely, it should be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. Although the invention has been disclosed with reference to its preferred embodiments, from reading this description those of skill in the art may appreciate changes and modification that may be made which do not depart from the scope and spirit of the invention as described above and claimed hereafter.

CLAIMS

I claim:

1. A method of well construction and completion comprising:
drilling a well with a fluid system into a target formation or reservoir;
inserting into the well a casing string including at least one extendable member having a sand control medium so that the extendable member is positioned adjacent a site in the target formation or reservoir;
extending the member until the members contacts the site in target formation or reservoir; and
placing the well on production.

2. The method of claim 1, wherein the fluid system is a "Drill-In Fluid."

3. The method of claim 1, further comprising the step of:
circulating a solvent through the well prior the placing step.

4. The method of claim 1, further comprising the step of:
circulating a solvent through the well after the placing step.

5. A method of well construction and completion comprising:
drilling a well with a fluid system into a target reservoir;
inserting into the well a casing string including an extendable member having a sand control medium so that the extendable member is positioned adjacent a site in the target reservoir;
extending the member until the member is in contact with the site of the target reservoir;
cementing the casing; and
placing the well on production.

6. The method of claim 5, wherein the fluid system is a "Drill-In Fluid."

7. The method of claim 5, wherein the extending step is after the cementing step.

8. The method of claim 5, further comprising the step of:
circulating a solvent through the well prior to placing step.

9. The method of claim 5, further comprising the step of:
circulating a solvent through the well after the placing step.

10. A method of well construction and completion comprising:
drilling a well with a first fluid system to a point above a target reservoir;
displacing the first fluid system with a second fluid system;
drilling a remaining portion of the well into the target reservoir;
inserting into the well a casing string including an extendable member having a sand control medium so that the extendable member is positioned adjacent a site in the target reservoir;
extending the member until the member contacts the site in target reservoir; and
placing the well on production.

11. The method of claim 10, wherein the second fluid system is a "Drill-In Fluid."

12. The method of claim 10, wherein the first fluid system is a convention drilling fluid.

13. The method of claim 10, further comprising the step of:
circulating a solvent through the well prior to placing step.

14. The method of claim 10, further comprising the step of:
circulating a solvent through the well after the placing step.

15. A method of well construction and completion comprising:
drilling the well with a first fluid system to a point above a target reservoir.
displacing the first fluid system with a second fluid system;
drilling a remaining portion of the well into the target reservoir;

inserting a casing string including an extendable member having a sand control medium so that the extendable member is positioned adjacent a site in the target reservoir;

extending the member until the member is in contact with the site in the target reservoir;

cementing the casing; and

placing the well on production

16. The method of claim 15, wherein the second fluid system is a "Drill-In Fluid."

17. The method of claim 15, wherein the first fluid system is a convention drilling fluid.

18. The method of claim 15, wherein the extending step occurs after cementing step.

19. The method of claim 15, further comprising the step of:

circulating a solvent through the well prior to placing step.

20. The method of claim 15,further comprising the step of:

circulating a solvent through the well after the placing step.

21. A method of well construction and completion in a target reservoir comprising:

drilling a well in with a fluid having a hydrostatic pressure that is less than or equal to the pressure of the target reservoir;

inserting a casing string including an extendable member so that the extendable member is positioned adjacent a site in the target reservoir;

extending the member until the member contacts the site in the target reservoir; and

placing the well on production.

22. The method of claim 21, wherein the fluid system is a "Drill-In Fluid."

23. A method of well construction and completion in a target reservoir comprising:

drilling a well in with a fluid having a hydrostatic pressure that is less than or equal to the pressure of the target reservoir;

inserting a casing string having an extendable member whereby the extendable member is positioned adjacent to the target reservoir;

extending the member to contact the target reservoir.

cementing the casing; and

placing the well on production.

24. The method of claim 23, wherein the fluid system is a "Drill-In Fluid."

25. The method of claim 23, wherein the extending step occurs after the cementing step.

26. A method of well construction and completion in a target reservoir comprising:

drilling the well with a first fluid system to a point above the target reservoir;

displacing the first fluid system with a fluid system having a hydrostatic pressure that is less than or equal to the pressure of the target reservoir;

drilling a remaining portion of well into the target reservoir;

inserting a casing string including an extendable member so that the extendable member is positioned adjacent a site in the target reservoir;

extending the member until the member contacts the site in the target reservoir; and

placing the well on production

27. The method of claim 26, further comprising the step of:

circulating a solvent through the well prior to placing step.

28. The method of claim 26,further comprising the step of:

circulating a solvent through the well after the placing step.

29. The method of claim 26, wherein the second fluid system is a "Drill-In Fluid."

30. The method of claim 26, wherein the first fluid system is a convention drilling fluid.

31. A well comprising a borehole and a casing inserted into the borehole, where the casing includes at least one extendable member having a retracted state and an extended state,

where the casing is designed to be positioned in the well so that the at least one member is adjacent a site in a productive formation and when extended forms a production conduit between the formation and an interior of the casing.

32. The well of claim 31, wherein the casing includes a plurality of extendable members, each of the members being positioned adjacent a site in the productive formation and each of the members designed to form a productive conduit between the productive formation and the interior of the casing.

33. The well of claim 31, further comprising a cement layer between a formation face of the productive formation and an exterior surface of the casing.

34. A well comprising a borehole and a casing inserted into the borehole, where the casing includes a plurality of extendable member having a retracted state and an extended state, where the casing is designed to be positioned in the well so that the members are adjacent sites in a productive formation and when extended form production conduits between the formation and an interior of the casing.

35. The well of claim 31, further comprising a cement layer between a formation face of the productive formation and an exterior surface of the casing.

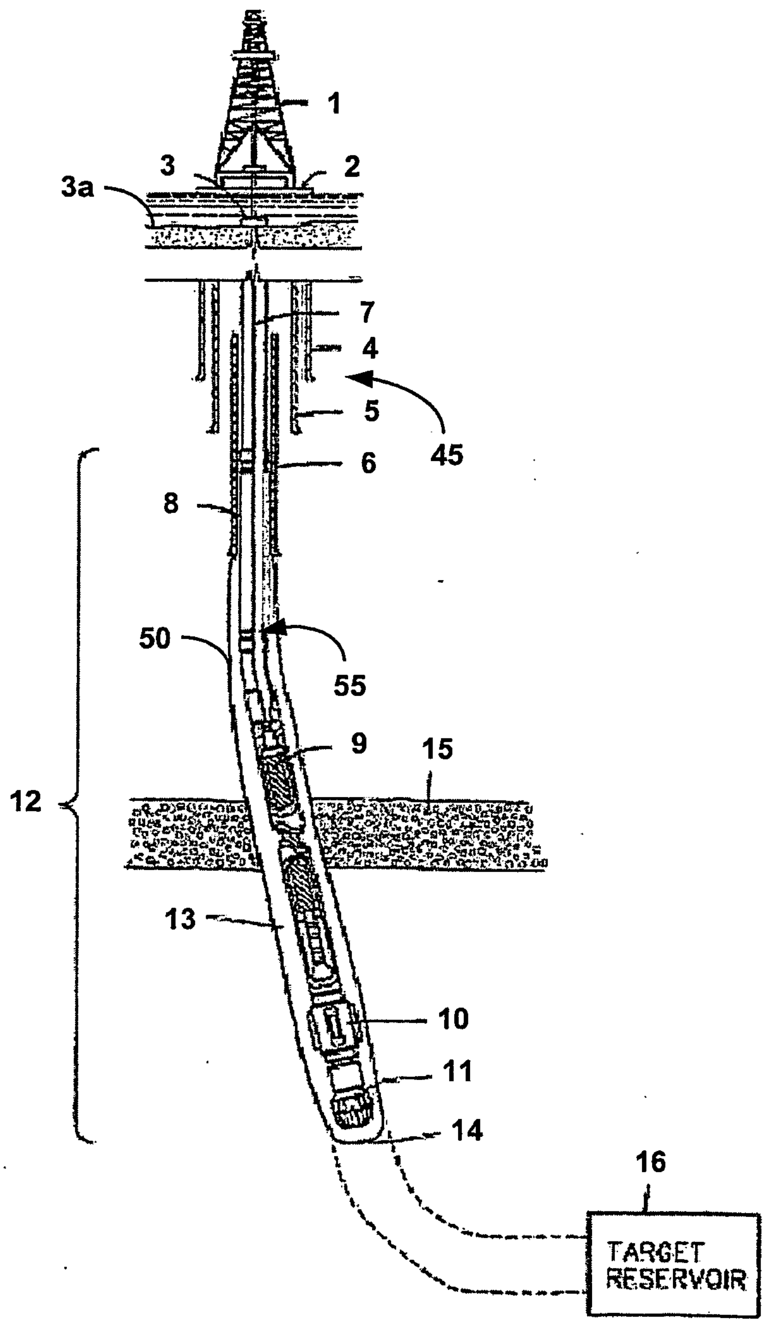


FIG. 1

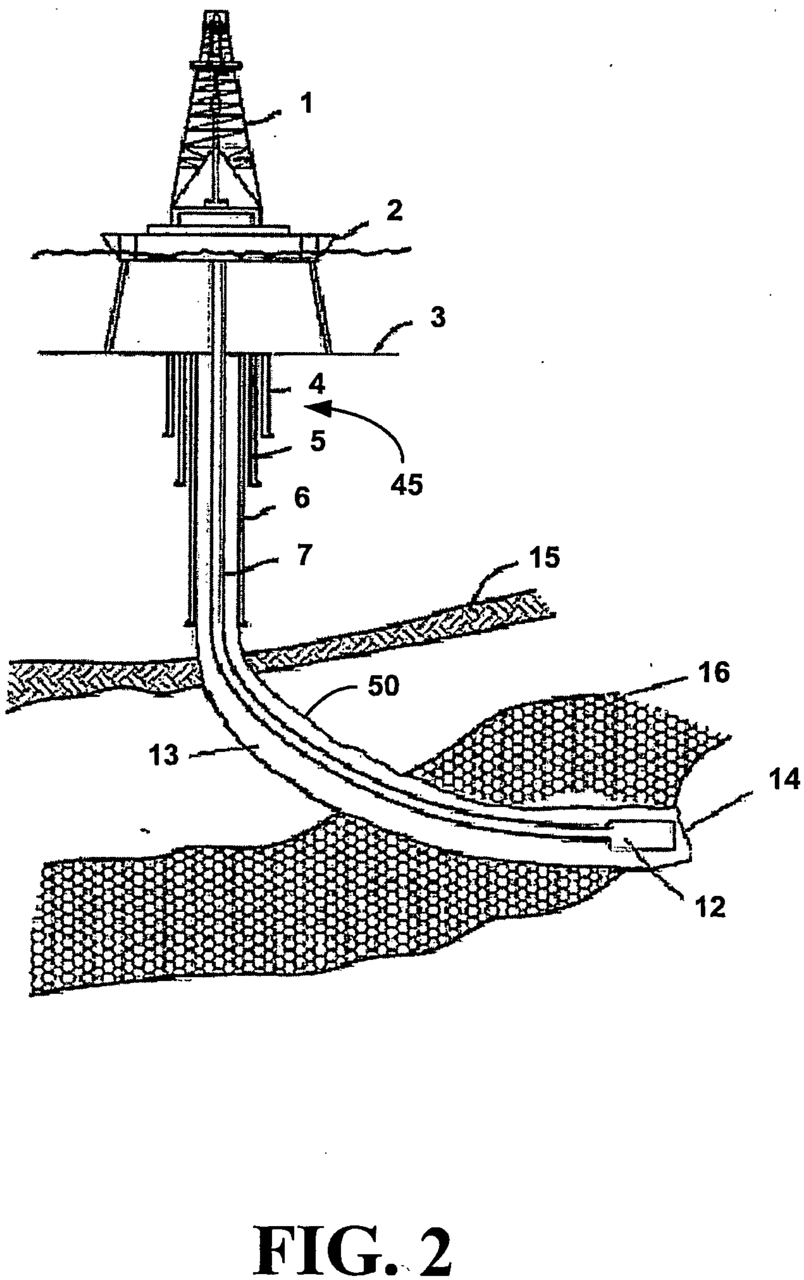


FIG. 2

FIG. 3A

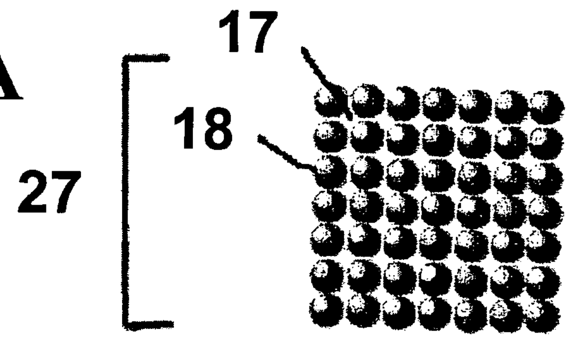


FIG. 3B

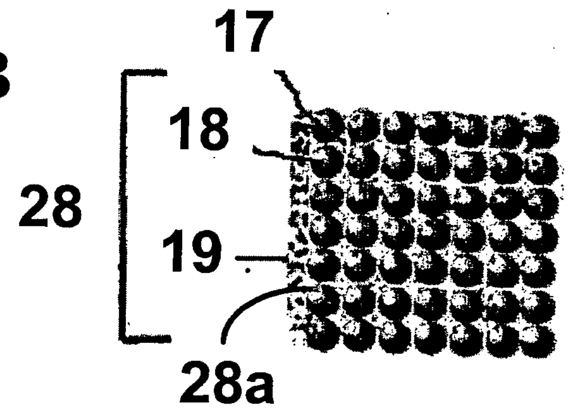
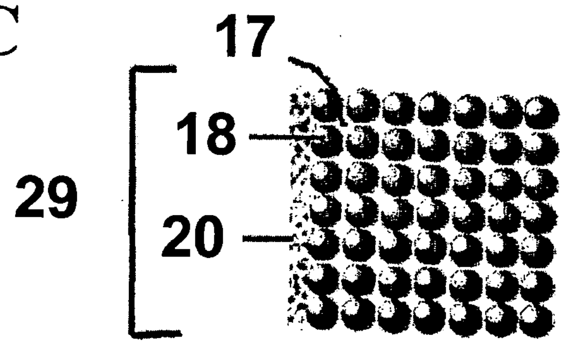


FIG. 3C



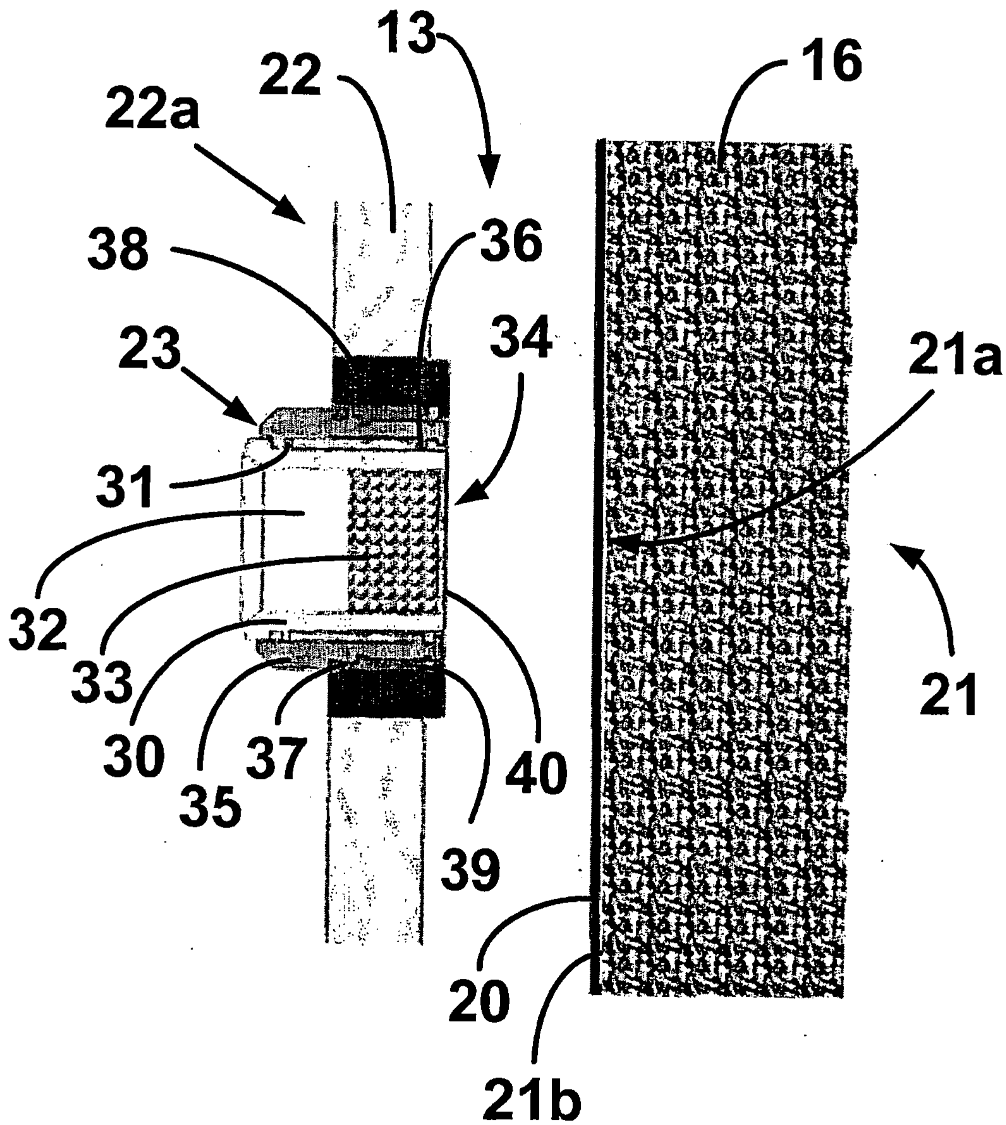


FIG. 4

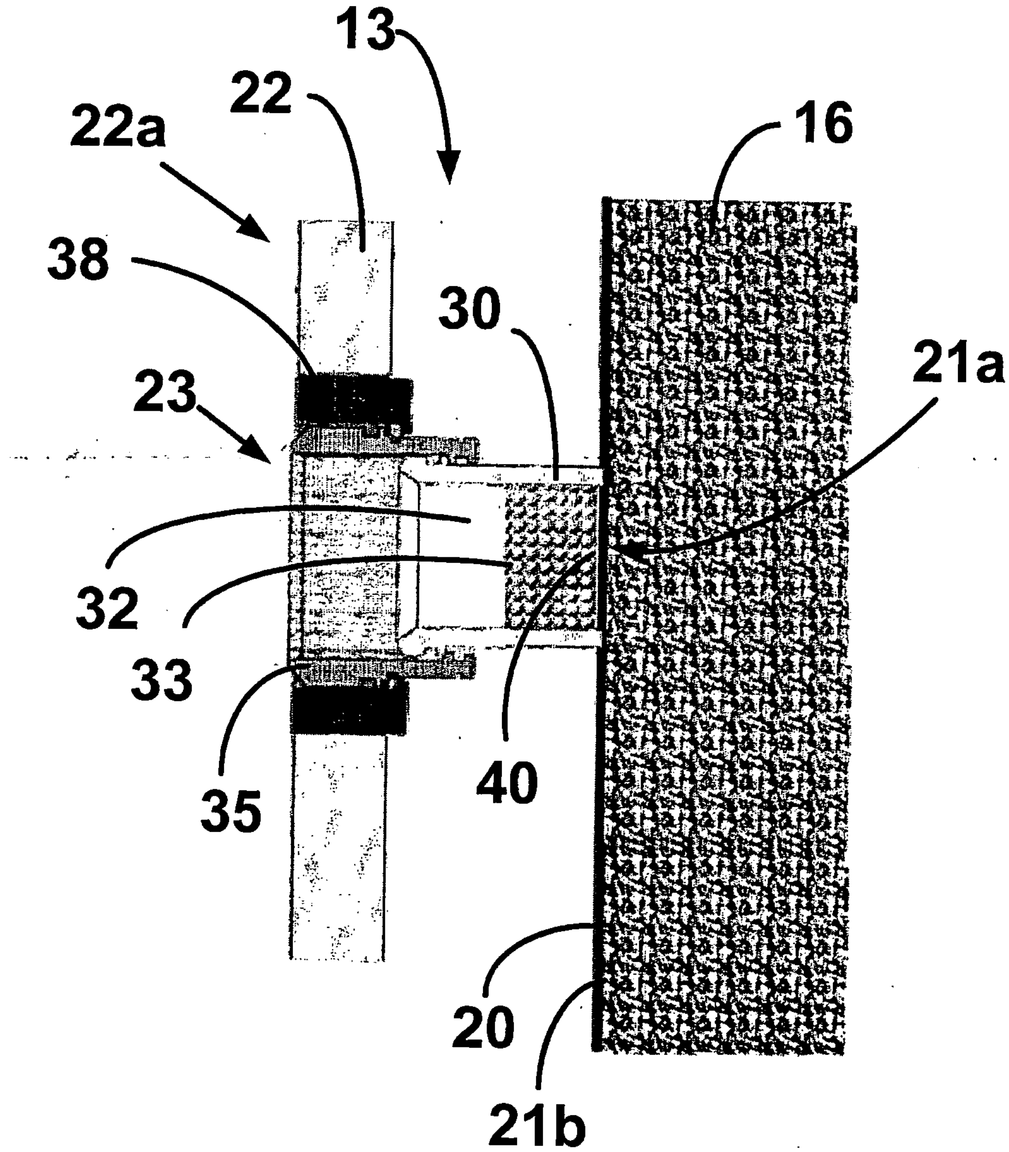


FIG. 5

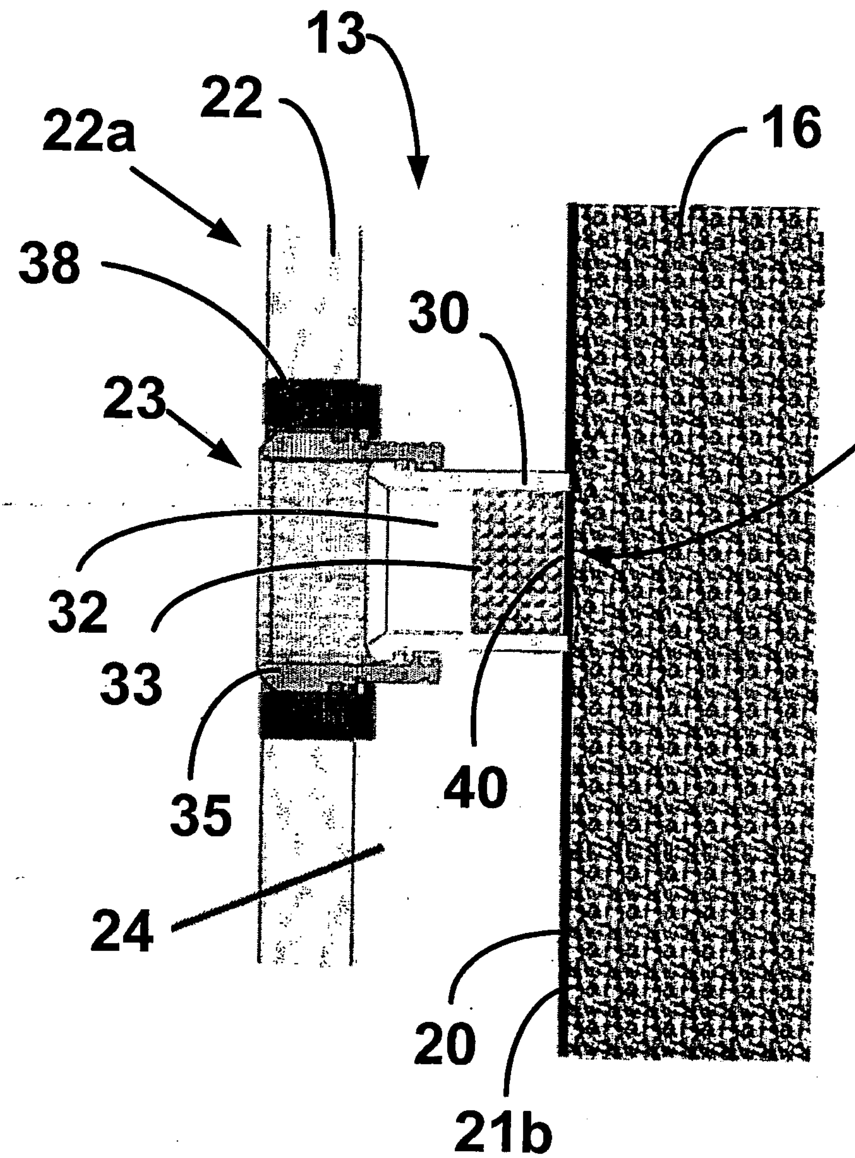


FIG. 6

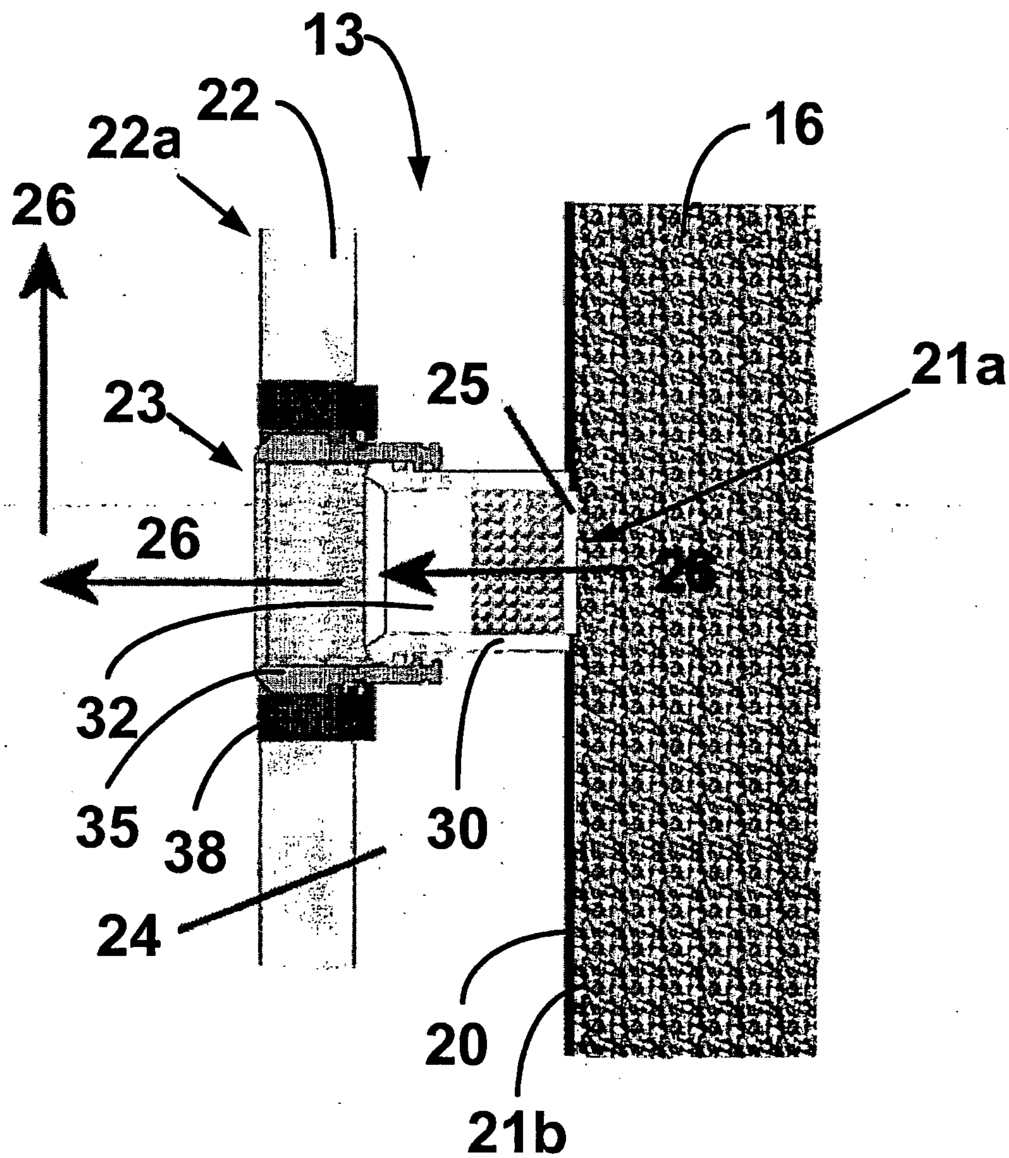


FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/40696

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B43/04 E21B43/11

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 505 260 A (MORAN LARRY K ET AL) 9 April 1996 (1996-04-09) column 3, line 28 -column 5, line 56 ---	1,5,10, 15,21, 23,26, 31,34
A	US 4 872 509 A (DICKINSON BEN W O ET AL) 10 October 1989 (1989-10-10) abstract ---	1
A	GB 995 517 A (NAT PETROLEUM CORP LTD) 16 June 1965 (1965-06-16) the whole document -----	1

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☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
28 April 2003	09/05/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Morrish, S

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 02/40696

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 5505260	A	09-04-1996	GB	2289297	A ,B	15-11-1995
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			MX	160919	A	19-06-1990
			US	4865128	A	12-09-1989
			US	5035285	A	30-07-1991
GB 995517	A	16-06-1965	NONE			

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